

## AN ADDRESS

ON THE

## ANTISEPTIC SYSTEM OF TREATMENT IN SURGERY.\*

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In compound fracture, as a general rule, healing by scabbing is that which should be aimed at. When this is attained, the treatment becomes greatly simplified; while the patient is saved any drain upon the system from purulent discharge, and any risks that may attend the presence of a granulating sore. With this object in view, it is necessary that the deeper layers of the dressing should be left to form the scab, and that, while the antiseptic is renewed from time to time externally, it should not penetrate to the surface of the wound; otherwise the carbolic acid will stimulate the tissues to granulation and suppuration, though without putrefaction.

But, it may be asked, Is it not objectionable to keep the wound permanently covered up? Is it not desirable to examine it from time to time, and ascertain what is going on in it? To this I would reply by another question. Does the surgeon think it needful, in a case of simple fracture, to make an incision and investigate the state of the broken bone, the torn muscles and fasciæ, and the other elements of the contused wound which, though the integument remains entire, exists as surely as in a compound fracture? No surgeon would think of such a course. And, on the same principles, provided no unfavourable symptoms are present, we may be well pleased to leave the deep portion of the dressing to serve as a temporary skin.

Yet it must be admitted, that to change the superficial layer of the dressing, without raising the deeper layers, is often a matter of great nicety, while the admission of septic air beneath the scab would be fatal to this mode of treatment. For, the dressing being purposely so arranged that the parts in immediate contact with the wound may be free from carbolic acid, receiving none from without to compensate for loss by absorption of that which they originally contained, the lower surface of the application becomes, in a day or two, devoid of all antiseptic properties, and the penetration of living germs beneath it would lead to putrefaction there, which would spread to any extravasated blood or dead tissue that might remain unabsorbed in the wound. Rather than run any serious risk of such an occurrence, it would be far better to change the whole dressing every day. For although this would necessitate granulation and suppuration, through the continued action of the acid upon the raw surface, yet the essential object of the antiseptic treatment would be attained; that object being not the avoidance of suppuration, but the prevention of putrefaction in the wound. It is of great importance to bear in mind this distinction, which, from want of clear ideas regarding the conditions which determine suppuration, is very liable to be overlooked. A patient may die of poisoning and irritation in compound fracture, from putrefaction of the blood extravasated in the limb, before sufficient time has passed for any pus to be formed; and, on the contrary, suppuration may take place in connection with compound fracture, whether from the action of the stimulating antiseptic on the wound or from the occurrence of abscess in the contused limb independently of atmospheric influence, without the patient's life being at all endangered, provided always that antiseptic treatment is perseveringly continued.

Nevertheless, the advantages of healing by scabbing are so great that it is worth while to endeavour to attain them, and I have been long striving to improve the method of dressing, so as to get rid, if possible, of the attendant risk. A plan which has, in most cases, answered well when the putty has been used, is to make the permanent dressing of two or three layers of lint somewhat larger than the wound, wrung out of a pretty strong solution of carbolic acid in oil, say one of acid to four of oil, and covered with a piece of oiled calico or linen rag extending about an inch beyond the lint in every direction. Over this is applied a

stratum of antiseptic putty, which is changed daily, or once in two days, according to the amount of discharge. The blood from the wound soaking into the lint is acted on by the carbolic acid, and changed into a firm substance which consolidates the deep dressings into a crust or scab, and this crust, while sufficiently thick over the wound to prevent the carbolic acid of the putty from penetrating to the raw surface, is so thin at its margins formed by the rag as to be there kept antiseptic through and through. Then, in changing the putty, the first thing seen on lifting up its edge is the thin margin of the calico; and even if this be accidentally raised a little, its antiseptic property prevents any mischief from resulting. The putty is spread on calico, and the calico is applied next to the deep dressing, to prevent adhesion, while the external surface of the putty is covered either with thin block tin or sheet lead, or, what more recently we found to answer quite as well, gutta percha tissue, which, though it permits carbolic acid to escape through it, is not objectionable on that account if the putty be sufficiently thick, while the gutta percha, like the metallic plate, prevents the putty from becoming dry and hard. The putty is made to overlap the permanent dressing well on all sides, and I may remark that, whether the impermeable antiseptic guard be composed of putty or not, it is of the utmost importance that it should extend freely beyond the source of the discharge in every direction, so that the putrescible fluid may have to flow for some distance beneath it before it reaches the atmosphere or any dressing containing active putrefactive organisms. The degree of overlapping of the crust by the external dressing must vary according to the amount of discharge which may be anticipated. When this is large, it should be to the extent of three or four inches. Failures have undoubtedly often occurred for want of attention to this essential point.

But though this method will, with proper care, generally succeed,\* it would be very desirable, if possible, to get rid of the trouble involved in it. At one time I hoped this might be done by means of the plaster above mentioned, by employing a layer of it instead of the calico as the upper part of the permanent dressing, so that the adhesiveness of the emplastrum might keep the whole deep dressing securely applied to the skin, except at limited spots where the discharge might ooze out; another layer of plaster being used instead of the putty, with calico moistened with a watery solution of the acid interposed to prevent adhesion of the two layers of plaster. My anticipations, however, have not been verified in this respect. For the plaster, though it answers extremely well for an external antiseptic guard, whether in compound fracture, incised wounds, or abscesses, has proved unsuitable for the permanent dressing. The substance of the emplastrum becomes softened by the solution of carbolic acid used to moisten the calico, and permits it to enter beneath it and soak into the lint below, and stimulate the raw surface to granulate and suppurate, and this was what occurred in the case of displaced foot above mentioned. At the same time the lint is kept moist, instead of forming a dry crust, and hence it may gradually shift its place along with the plaster that covers it, involving the risk of leaving the wound insufficiently overlapped, if not exposed. I have experienced this inconvenience in two cases of compound fracture which have been treated in this way. One of these was an old lady, of 75, in whom the *os humeri* was severely comminuted just above the elbow-joint, with a considerable wound from which six loose fragments were extracted; the other, was a boy, 12 years old, whose right thigh was much contused as well as broken by machinery. These cases, indeed, have done well; osseous union having occurred as early as if the fractures had been simple ones. But in both of them the wounds healed by granulation instead of by scabbing.

With the view of getting over these difficulties I sought to obtain some kind of antiseptic cement, by which a portion of dressing might be glued down firmly upon the skin. Among other materials I tried shell-lac, and, in so doing, I accidentally hit upon a substance which appears preferable to the plaster for almost every purpose. I found that this resin could be mixed with carbolic acid in any amount by aid of heat, the result, when cooled, varying, according to the quantity of the acid, from brittleness to fluidity, the intermediate proportions giving a firm but flexible solid with a certain degree of elasticity, approaching to some extent the characters of caoutchouc. It further turned out that the lac thus associated with the carbolic acid retained it with great tenacity,† so that a thin layer spread on calico may be used to store up a large quantity of the antiseptic, forming an application which retains its virtues for days at the temperature of the body, and at the same time,

\* For an admirable example of success with this method, the reader is referred to the *Lancet*, August 29th, 1868, where Mr. Cresswell, of Merthyr Tydvil, reports a case of gun-shot wound of the femur, shattering the trochanteric region and neck of the bone; the wound by which the ball entered posteriorly and that in the groin by which it was extracted by incision, both healing completely by scabbing, under a crust of oiled lint, covered with antiseptic putty, daily renewed.

† In this respect, lac differs altogether from India-rubber, which, though it may be impregnated with the acid to any degree, parts with it rapidly.

\* Continued from page 463 of JOURNAL for October 31st, 1868.

† The Address as actually delivered continued the discussion of the principles of the dressing, and gave details of the mode of procedure, supposing the lead-plaster to be employed in the form in which it was then described. In order to enable me to introduce subsequent improvements, I have thought it best entirely to remodel the remainder, though retaining to a certain extent its original features.—J. L.

fails to irritate the skin. It has also this great advantage over the lead plaster, that it cannot be softened by either a watery or oily fluid. The only imperfection which it appeared to shew, when used in practice as an external antiseptic guard, was that when long applied to the skin it adhered to the surface, whereas it is desirable that such a dressing should adhere very slightly if at all. This objection to it I attempted to obviate by spreading it upon gutta percha tissue which, though insoluble in carbolic acid, allows it to travel through its substance. The lac when thus lined with gutta percha proved none the less efficient as an antiseptic, and, being perfectly devoid of adhesiveness and of smooth surface, shed the discharge in a most perfect manner, greatly excelling, in this respect, the lead plaster. But it had one fault, viz., that when subjected to much bending, as at the fold of a joint, the gutta percha cracked and admitted the discharge which, gradually insinuating itself, detached the gutta percha more or less extensively, and introduced an element of risk through the interposition of a layer of liquid between the antiseptic lac and its lining. This fault has been got rid of by reducing the gutta percha to a mere film, incapable of affording lodgment for fluid, by brushing over the antiseptic lac with a weak solution of gutta percha in bisulphide of carbon which, rapidly evaporating, leaves a coating of microscopic thinness, yet effectual for preventing adhesion. We have now given this lac dressing a sufficient trial in wounds and abscesses to entitle me to recommend it with confidence.\*

For an antiseptic dressing that is intended to be changed from time to time, perfect absence of adhesiveness is a most valuable property; not only because it permits all discharge to escape beneath it into the porous material placed outside to absorb it, but because it avoids traction upon any deeper dressing or upon the skin during the process of withdrawing it, with the concomitant risk of regurgitation of air or liquid charged with living putrefactive organisms.

But for the permanent dressing in compound fracture this complete want of adhesiveness is the converse of what we desire. Here, the material employed, being designed to form part of the scab, should stick to the skin or to anything else that lies beneath it. The lac prepared as above described may, however, be readily made suitable for this purpose, by rubbing off the film of gutta percha by firm friction with a dry cloth, and then brushing the surface over with liquid carbolic acid. It then, at once, assumes a sufficient degree of adhesiveness.

In order to ensure healing without suppuration, it is requisite, as we have seen, not only to prevent the spreading of putrefaction into the wound, but also to protect the raw surface from perpetual stimulation by the carbolic acid. In the mode of dressing, above described, in which the putty was employed, the latter object was attained by means of layers of lint forming a crust too thick to be penetrated by the acid supplied externally; and the same plan would, no doubt, succeed as well with the lac. But to trust to the mere thickness of a penetrable crust, is not altogether satisfactory. It would clearly be better, if possible, to protect the exposed tissues from the stimulating antiseptic in the lac by a layer of some substance chemically impermeable to carbolic acid. A metallic plate possesses this property; and in its more flexible forms, such as thin block tin or sheet lead, it seems likely, at least in ordinary cases, to answer well. I have, as yet, only had opportunity to try this method in two cases, but both of these have presented points of interest which make them deserving of mention.

*Case of Contused Wound treated with Block Tin and Antiseptic Lac.*—The first was a contused wound, three inches long, over the lower part of the tibia, with some undermining of the skin, in a young man of 20, occasioned by the limb being violently squeezed between a heavy iron pipe and a fixed piece of machinery. Happening to be at the Infirmary soon after his admission, I dressed the case myself, washing and syringing out the wound with a saturated watery solution of carbolic acid, and covering it with a well-fitting piece of thin block tin of rather larger size, washed with the watery solution, and then applying a piece of lac-plaster, deprived of its gutta percha layer, overlapping the tin freely on all sides. A piece of calico was placed outside the lac-plaster, to prevent adhesion of its edges to a dry cloth, which was wrapped round the leg to absorb discharge, and was intended to be changed. Next day, there was a good deal of sero-sanguineous effusion on the cloth, for

which another was substituted, moistened with a solution of carbolic acid in four parts of olive oil. The same was afterwards done daily; the discharge diminishing rapidly, and the limb remaining free from swelling or pain, and the constitution from disturbance, till, on the fourth day, the patient, who was a silly youth, was seized with a desire to see the injured part, and tore off all the dressings. This foolish proceeding on his part gave us the opportunity of making an interesting observation. The wound was found perfectly level with the general surface of the skin, being filled with a clot of smooth surface corresponding to that of the tin which had covered it, while the edges of the skin were pale and natural in appearance. The dressing was re-applied as before, the wound being superficially washed with carbolic acid lotion in the process. Two days later the patient again, without any reason, laid bare the wound, which still presented the same characters, except that the surface of the smooth clot shewed, here and there, some minute whitish specks, probably in consequence of the action of the watery solution of carbolic acid with which it was washed two days previously. A similar dressing was again employed, the use of carbolic lotion being again necessarily involved. After two more days, that is to say a week after the accident, the patient, though free from symptoms, having again removed the dressings, the wound was again examined. It was free from pus or odour of putrefaction, but its surface was mottled with red and yellow spots, and was not quite level. The dressing was continued one day longer, when it was abandoned, as the patient could not be induced to leave it alone, water-dressing being used instead; and on the following day the wound presented the characters of a healing superficial granulating sore. Two days later, he was so unruly that he was discharged for misconduct.

In the following case we have had the opportunity of seeing the effects of this mode of dressing when left undisturbed.

*Case of Compound Fracture of the Leg treated with Block Tin and Antiseptic Lac.*—On the 3rd of October, 1868, a porter, 25 years old, was unloading a waggon in a warehouse, when a box, weighing about four hundred-weight, slipped, and striking him upon the left leg, knocked him down over an opening in the floor, through which he would have fallen into the room below had not the heavy box, pressing upon the limb, pinned him down and kept him suspended. When rescued from this situation, he was taken to the Infirmary, where my house-surgeon, Mr. Malloch, found the leg much distended with extravasated blood, with a wound, three-eighths of an inch in length, on the inner side, about midway between the knee and ankle, bleeding freely and communicating with a transverse fracture of the tibia. A probe (smeared with an oily solution of carbolic acid to prevent the introduction of septic particles) could be introduced beneath the undermined fascia for about three inches in every direction except downwards, and also passed, for the same extent, directly outwards behind the tibia which was felt to be denuded of its periosteum. Having injected into the wound, with a syringe, several ounces of a saturated watery solution of the acid, and diffused it freely through the limb by pressure, to mix it with the extravasated blood, Mr. Malloch placed a piece of thin block tin about an inch square over the orifice, and, after pressing out as much as possible of the blood and watery solution, applied a piece of lac plaster deprived of its gutta percha lining, overlapping the tin a couple of inches in every direction, and over this a folded cloth moistened with a solution of carbolic acid in four parts of olive oil. The limb was then put up in lateral pasteboard splints. This treatment relieved the severe pain which he was suffering; but it returned in the course of the next few hours, during which very free hæmorrhagic effusion occurred. Next day the discharge became greatly diminished, and in the course of the following day it ceased entirely. The pain also left him about twelve hours after the accident and never returned. The after treatment consisted for the first two days, in renewing the oily cloth once in the twenty-four hours; but from the third day onwards the cloth was left permanently upon the limb and merely brushed over with a mixture of equal parts of carbolic acid and oil, the inner splint being raised for the purpose without disturbing the limb, which lay upon its outer side with the knee bent. After the sixth day, the antiseptic oil was only applied once in forty-eight hours. On the third day, some wrinkling of the epidermis indicated subsidence of the swelling which afterwards fell rapidly till, by the eleventh day, the calf was almost of natural size, having shrunk away considerably from the splint. His pulse never rose above 82, which was its number the day after the accident, and his general health was from that time forward quite unaffected.

Ten days after the receipt of the injury, it was noticed that the oily cloth, which for a week past had indicated complete absence of discharge, exhibited an appearance of additional staining, corresponding to two or three drops of red serum which seemed to have been pent up beneath the lac plaster by inspissation of the blood and serum round its margins, till some accidental cause, such as the shrinking of the limb,

\* This plaster is supplied at a very moderate price by the New Apothecaries' Company, Glassford Street, Glasgow, to whom I am much indebted for the interest and pains they have taken in bringing it to perfection. The following is the mode of its manufacture:—Take of shell lac, 3 parts; crystallised carbolic acid, 1 part. Heat the lac with about a third of the carbolic acid over a slow fire till the lac is completely melted; then remove from the fire and add the remainder of the acid, and stir briskly till the ingredients are thoroughly mixed. Strain through muslin, and pour into the machine for spreading plaster; and, when the liquid has thickened by cooling to a degree ascertained by experience, spread to the thickness of about one-fiftieth of an inch. Afterwards, brush the surface of the plaster lightly with a solution of gutta percha in about thirty parts of bisulphide of carbon. When the sulphide has all evaporated, the plaster may be piled in suitable lengths in a tin box without adhering, or rolled up and kept in a canister.

cracked the dried exudation. Having been led to disturb the dressing to some extent in investigating the source of this discharge, I thought it best to remove it entirely, protecting the wound at the moment of its exposure with a bit of antiseptic lint. The under surface of the lac gave distinct indications of being impregnated with carbolic acid. The wound presented a very interesting appearance. It had shrunk considerably; but its margins resembled those of a perfectly recent wound; and its orifice was occupied by a projecting dark clot, which to the naked eye scarcely differed from a fresh coagulum. Hence there seemed reason still to hope for healing without suppuration, if the original mode of dressing were repeated. Accordingly, the tin smeared with carbolic acid was replaced, and overlapping it a fresh portion of lac plaster, rendered adhesive by touching it with carbolic acid after removing the film of gutta percha, except in a narrow space from the centre to one side, where the gutta percha was left, to provide for the escape of discharge. A dry cloth and the splint completed the dressing. Two days later, in order to maintain the lac plaster in an antiseptic condition, two layers of calico, moistened with a solution of carbolic acid in four parts of olive-oil, were substituted for the cloth; and afterwards, at intervals of from two to three days, the surface of the calico was lightly brushed over with a mixture of equal parts of the oil and acid. For six days, some yellowish serum, amounting at first to one or two minims in twenty-four hours, but gradually diminishing, exuded from below that part of the margin of the lac plaster where the gutta-percha film had been left, the amount being estimated by changing every day a little bit of antiseptic lint placed at the point of exudation. But, after the sixth day, the piece of lint was left unchanged, as the trifling discharge seemed to have ceased entirely. When eleven days more had passed without any change, I thought it well to ascertain again the state of the wound; and on October 30th, seventeen days after the second application of the deep dressing, and two days short of four weeks after the accident, I pulled off the lac plaster with the tin adhering to it. The plaster was still sticking to the skin, and drew away the hairs along with it, except where the gutta-percha film remained. At this part, along the course of the track of exudation, the skin had an orange stain, from serum mixed with altered hæmatin, and was moist, except near the edge of the plaster. Beneath the tin, also, there was the same kind of orange moisture. The wound appeared at first sight unhealed, having an orange-red aspect; but, on wiping it with a piece of lint, a perfect cicatrix was disclosed, which had been covered with the remains of the little portion of clot seen projecting from the orifice on the former occasion of exposing it. A piece of dry lint was placed upon the scar; and the splints were readjusted, the fragments being in good position. The case was now reduced to one of simple fracture.

This case presents several features of great interest. In the first place, the appearances disclosed on the removal of the dressings on the tenth day after the accident, afford as good an illustration as could be desired of the fact that the surface of a wound is not induced to suppurate, or indeed to undergo any appreciable change by the contact of a foreign body, destitute of chemically stimulating properties. The carbolic acid with which the surface of the tin was washed, like that injected into the wound, was absorbed into the circulation before it had time to bring about those changes in the part which are the essential preliminary to suppuration. The tissues of a recent wound are incapable of forming pus, however much they may be stimulated, whether by nervous (*i. e.*, inflammatory) excitement, or by chemical irritants, such as the products of putrefaction or pungent antiseptics. It is only when they have been gradually changed under the influence of prolonged abnormal stimulation into that rudimentary form of tissue which, when we see it on the surface of a sore, we term granulations, that they are liable to produce, when still further stimulated, the still more rudimentary pus corpuscle. It is upon this that the possibility of obtaining primary union on the antiseptic system depends. The antiseptic applied to the wound in the first instance is a powerful stimulant, but it is absorbed before it has time to bring about granulation in the tissues.

In the second place, it is very satisfactory to see, although theoretically it could hardly have been doubted, that, when a wound has been effectually protected from stimulation and consequent granulation, it may, even at a late period after its infliction, be again subjected to the temporary stimulus of an antiseptic application without being made to suppurate; for a knowledge of this fact will enable us to examine the wound when we think there is a fair prospect of healing being complete, confident that, should the reverse prove to be the case, we can again employ the original mode of dressing without interfering with the process of healing by scabbing.

Thirdly, I may remark that cicatrization without suppuration beneath a piece of tin, is a novel mode of healing by scabbing. But the ordinary scab is in so far analogous to the metallic plate, that the exudations of

which it is composed having dried before they had time to putrefy, the crust is, like the metal, a neutral or unstimulating solid. Further, there is putrescible moisture beneath the scab as beneath the tin; but the mode in which the putrefactive organisms are excluded is essentially different. The scab keeps them out mechanically, by adhering firmly to the surface of the integument; the metallic plate opposes no mechanical barrier to their entrance, but is guarded by a germ poison in the surrounding lac which no less imperatively forbids their access.

Altogether, the case must be regarded as affording great encouragement for giving a further trial to this method, which seems to bring the treatment of compound fracture to something nearly approaching perfection. The lac, being impermeable to discharge, combines the properties of an external antiseptic guard with those of a permanent crust; and, as fresh carbolic acid can be supplied to it as often as may be desired without disturbing its position, the trouble and risk that attended the changing of the putty are entirely got rid of. At the same time the tin protects the raw surface from the acid with absolute certainty, while the tin and the lac constitute together so thin a layer as not to alter the contour of the limb, or interfere with the shape of splints as would be used for simple fracture; a considerable advantage as compared with the mass constituted by a thick crust, covered with substantial putty. When the wound is large, I would advise the use of two layers of the lac plaster for the sake of additional strength, the outer one overlapping the inner by an inch or two; and the outer, like the inner, rendered adhesive, as above described, so that the two may become incorporated into one mass. Also, I would recommend that, as was done in the second dressing of the last case, the film of gutta percha should be left upon a track leading from the tin to what is to be the most dependent part of the edge of the plaster to afford free egress for sero-sanguineous discharge.

For treating the interior of the wound in compound fracture, I employed, till comparatively lately, the undiluted acid, and, as this afforded excellent results, I did not venture to change the practice without having some more substantial basis than hope to found upon. But rather more than a year ago, having observed that the injection of a saturated watery solution (one part of acid to twenty parts of water) among the fibrous tissues in a foetid suppurating wound of the palm, completely arrested the existing putrefaction, I concluded, that if the acid so diluted sufficed to destroy the abounding putrefactive organisms which must have been present among the textures in that case, it must surely be trustworthy for compound fracture. We have accordingly employed the saturated watery solution in all the numerous cases of compound fracture that have since come under my care, and in no instance has it failed. If it answers equally well, it is obviously superior to the strong acid, since it does not produce the slightest sloughing from caustic action, and, being a less powerful irritant, causes a less copious serous effusion. Besides, it may be injected and diffused among the tissues which are the seat of extravasation with a freedom which could not be used with the acid of full strength, and it is to this circumstance that I am disposed to attribute the fact that we have obtained success at a period after the infliction of the injury which I should formerly have thought quite hopeless, in one case, for example, as late as thirty-six hours after the accident. Lastly, we avoid a disagreeable symptom which we used to observe occasionally after applying the undiluted acid freely to large wounds, *viz.*, obstinate vomiting for about twenty-four hours, occasioned, no doubt, by imbibition of a poisonous dose into the circulation.

[To be concluded.]

**THERAPEUTIC USES OF OXYGEN.**—M. Constantin Paul sums up a paper on this subject as follows. 1. Oxygen is not a poisonous gas; and thirty litres of this gas in the pure state can be inhaled for several days without any accident. It is only at the end of two or three weeks that fever is produced. 2. Oxygen is a valuable resource in cases of asphyxia, especially when this is due to accidental suffocation. It may be useful in cases of strangulation, hanging, and drowning, as well as in poisoning by noxious gases or vapours. 3. Oxygen is a valuable remedy in nervous asthma. In humid asthma—*i. e.*, the catarrh which complicates emphysema—it will also be of good service, provided its use be persisted in. 4. In phthisis, oxygen has not given such good results as were expected. It produces immediate relief, and this is very valuable; but fresh exacerbations follow, more intense, perhaps, than the first. It can, then, be regarded only as a palliative. 5. In albuminuria, oxygen may become a valuable remedy, if it be found, by further observation, to cause the albumen to disappear from the urine, as was observed in a case by Eckart and in one under the author's care. In any case, the remedy should be tried. 6. The same remark is applicable to diabetes. 7. In local gangrene, if there be not obliteration of the arteries, oxygen is a sovereign remedy.—*Bulletin Génér. de Thérap.* 15 August, 1868.